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*On the Mortality in the United States of America, as deduced from the last Census, in 1860. By SAMUEL BROWN, V.P.S.S., Vice-President of the Institute of Actuaries.*

[Read before the Institute, 25th February, 1867.]

THERE is no country in which, from a combination of circumstances, a census, if accurately taken, is more likely to afford novel and interesting materials than the United States of America. The marvellous progress of the nation, which, in the last 70 years, has increased in numbers from less than 4 millions to nearly 31½ millions in 1860, is alone sufficient to suggest changes in population, in wealth, commerce, cultivation of land, means of transport and circulation, growth of towns, &c., which, if the facts were carefully examined, would throw light upon many obscure questions in social and political economy, and even by the disturbance of their ordinary laws modify and correct the theories which have been mooted.

But the question of population is more than sufficient for our present inquiry, whilst at the same time it stands at the head of all others for its importance and interest. I have, therefore, taken some pains to examine and analyze the volume showing the final exhibit of the Eighth Census of the United States, which was published last year at Washington, under the direction of the Secretary of the Interior.

As far as regards the population and mortality, the preparation of the returns was committed to the care of Dr. Edward Jarvis, a distinguished writer on statistics, of great ability, and a Corresponding Member of the Statistical Society of London. Considering the difficulties of his task, and the imperfections of his data, which I shall have to point out, he has made the most of the materials at his command, and suggested at least reflections on many novel topics worthy of further research.

*Population returns.*—The schedules of population were obtained by 4,414 marshals, in the summer of 1860, at the houses of the families in the whole country. They were digested and put in order in the Census Office, and the tables then referred to Dr. Jarvis for his Report thereon. By him the facts were analyzed and new combinations formed. We conclude from this general description that the schedules were not filled up with the statements of the existing population on any given day or night; but that the inquiries were conducted from house to house, as was most

convenient to the officers, in the course of the summer. This is a primary and important defect in the collection of the returns, for in a population so shifting and changeable, very great differences might be found, even in the course of a few weeks, in the various States. It would be impossible to prevent individuals, and even whole families in some cases, being enumerated twice or more times by different officials; and others, who may move into a locality which has been already visited, being wholly omitted. It is possible that the omissions may balance the duplicate returns; but a census should be a collection of facts, not conjectures. No doubt the difficulty would be very great of obtaining a simultaneous numbering of the people of a country of such vast extent and in many districts so thinly peopled, requiring often many miles to be traversed for a few isolated facts. But this is a mere question of expense, and of increasing the number of marshals; and the Government seems by no means niggardly in carrying out this great work, since the appropriation for the purpose, in 1860, was no less than two millions of dollars.

*Division into districts.*—In order the better to compare the results, the whole country has been divided into nine large districts, arranged according to their geographical position and climatic character. They are as follows:—

- District I. Maine, New Hampshire, Vermont, Massachussets, Rhode Island, Connecticut, and New York.
- „ II. Michigan, Wisconsin, Minnesota, and Nebraska.
- „ III. New Jersey and Pennsylvania.
- „ IV. Ohio, Indiana, Illinois, Iowa, and Kansas.
- „ V. Delaware, Maryland, District of Colombia, Virginia, and North Carolina.
- „ VI. Kentucky, Tennessee, and Missouri.
- „ VII. South Carolina, Georgia, Florida, and Alabama.
- „ VIII. Mississippi, Louisiana, Arkansas, and Texas.
- „ IX. California, Oregon, Washington, New Mexico, Utah, Dacota, and Nevada.

The United States extend from 25° to 49° north almost as far south as the torrid zone. In this vast extent of territory, with low-lying swampy lands on the coast and mountains thousands of feet high in the interior, in regions cultivated or in a state of wild nature, drained or moist, in plains exposed to winds or in sheltered valleys, under the burning sun of the south to the mild and sometimes severe temperature of the north, every variety of climate, and, as regards the mortality, every disease that afflicts human nature may be expected to be found. In this arrangement of

districts the object has been to bring together such States as most nearly accord in their climates. Even then the range is great. In I., Maine and New York, the range in the mean temperature is  $75^{\circ}$ ; from  $6^{\circ}$  in January to  $81^{\circ}$  in July. In V., Maryland,  $60^{\circ}$ ; from  $24^{\circ}$  in January to  $84^{\circ}$  in July. And in VII., South Carolina and Georgia,  $50^{\circ}$ ; from  $37^{\circ}$  in December to  $87^{\circ}$  in July.

*Population in districts.*—The following table shows the white and coloured population in the nine districts according to the Census 1860. (See next page.)

By the last three columns will be seen the proportion which the coloured population (including in that term, as I understand it, blacks and mulattoes) bears to the white population in each district, the numbers given being the proportion to 10,000 males, 10,000 females, and 10,000 of both sexes in each district. The smallest proportion is in II., Michigan, &c.; and the larger proportion in VII., South Carolina, Georgia, Florida, and Alabama, where the coloured are not far short of equalling the white population in number, and in VIII., Mississippi, Louisiana, Arkansas and Texas, where they amount in number to nearly three-fourths of the whites.

*Increase of population in districts.*—The districts, of course, differ very much in other respects in the nature of their respective populations, especially as to the ages into which the inhabitants are distributed. Some have been inhabited for more than 200 years, others have scarcely been settled for a few years, quite within the present generation. It is only in the former that we can look for the due proportion of people at all ages which are found in the old States of Europe, and then only if they do not continue to be disturbed by the admission of immigrants from Europe or from the other American States. If the immigration is numerous, there is naturally an excess of population in the manhood period of life. There the proportion of young children is small, and of aged persons, compared with the totals, smaller still. After a time, if the immigration ceases or diminishes, the early marriages of men in the prime of life lead to a great and unusual proportion of infants and young children to the whole population; whilst the parents having entered the population not at birth but in advanced life, tend to increase the proportion of the older ages sooner than they would in the old populations of Europe.

Some of the States have increased with extraordinary rapidity in the last ten years, both by immigration and by births from recent marriages, thus showing a great preponderance of numbers

A, showing the White and Coloured Population of the United States in Districts.

District.	WHITE.			COLOURED.			PROPORTION OF COLOURED TO EVERY 10,000 WHITE IN EACH DISTRICT.		
	Males.	Females.	Persons.	Males.	Females.	Persons.	Males.	Females.	Persons.
I. Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York	3,441,151	3,500,919	6,942,070	34,897	38,819	73,716	101	110	108
II. Michigan, Wisconsin, Minnesota, Nebraska	902,708	805,218	1,707,926	4,387	3,930	8,317	48	48	48
III. New Jersey, Pennsylvania	1,750,676	1,745,282	3,495,958	38,785	43,482	82,267	221	248	235
IV. Ohio, Illinois, Indiana, Iowa, Kansas	3,176,693	2,949,385	6,125,378	28,894	28,531	57,425	90	96	93
V. Delaware, Maryland, District of Columbia, Virginia, North Caro- lina	1,174,875	1,169,636	2,344,511	559,275	558,228	1,117,503	4,760	4,772	4,766
VI. Kentucky, Tennessee, Missouri	1,460,103	1,349,592	2,809,695	317,075	320,524	637,599	2,171	2,374	2,269
VII. South Carolina, Georgia, Florida, Alabama	758,544	728,324	1,486,868	682,803	695,662	1,378,465	9,001	9,551	9,270
VIII. Mississippi, Louisiana, Arkansas, Texas	775,983	680,406	1,456,389	547,545	534,412	1,081,957	7,056	7,854	7,429
IX. California, Oregon, Washington, New Mexico, Utah, Dakota, Nevada	403,295	184,272	587,567	3,077	1,402	4,479	76	76	76
Total	13,844,028	13,112,934	26,956,962	2,216,738	2,225,990	4,442,728	1,601	1,697	1,647

in the early and middle periods of life. In others, the youthful and middle-aged have emigrated to more promising fields of enterprise, leaving their children and parents behind, and consequently exhibiting the very young and the older ages in relatively larger proportions.

Again, in what may be called immigration districts, it is natural to expect that there should be found a greater proportion of males, at any rate until the cultivation of his land, or the obtaining steady employment, allows the unmarried emigrant to feel that he is settled enough to support a wife and family, or, if he is already married, to bring them over from abroad. On the other hand, more females may be expected in proportion to the total inhabitants where the younger portion of the males emigrate from the district to cultivate new lands, or to push their fortunes in newly-rising localities.

In a table which is given of the growth of population in each district in each decennial period of years since 1790, the numbers somewhat differ in 1860 from Table A, which I have given above, but not so as materially to affect the results; and as the relative growth is more interesting than the actual numbers, the following table will suffice to show the rate per cent. at which each district has increased in the last 70 years:—

*B.—Rate per Cent. of Increase of Population of the United States, in Districts, in each Decennial Period.*

Decennial Period.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
To 1800	34	..	31	..	16	199	53		
" 1810	33	..	29	432	12	111	31	1,220	
" 1820	24	..	25	192	10	53	45	107	
" 1830	27	255	25	83	13	43	48	57	
" 1840	20	668	25	79	2	31	33	64	
" 1850	24	191	23	47	16	33	26	120	
" 1860	20	130	27	44	14	29	17	83	225

This table affords the most singular results. We remark not only the rapid growth of population in the first 10 years after the settlement of some of the districts—as VIII., principally slave States, and IV., which commenced in the same period; II., which increased with two-and-a-half-fold greater rapidity in its second 10 years; and IX., California, &c., which 20 years ago was not included in the census as possessing any inhabitants—but we also see the varying rate of progress of the different States in the last 10 years, from V., containing some of the oldest settled States, which has

increased only 14 per cent., to IX., California and the new States, which in the same period has increased 225 per cent. District II. has continued at a very high rate throughout the whole period of 40 years.

The total white population at the census in 1850 was stated to be 19,553,068; in 1860, 26,956,962, an increase of 37·9 per cent. The coloured, including free and slaves, in 1850 was 3,638,808; in 1860, 4,442,728, showing an increase of 22·1 per cent.; and on the total, from 23,191,876 to 31,399,690, the rate of increase was 35·4 per cent.

*Population classed under ages.*—The next most important inquiry is as to the distribution of the population under ages. All the conditions of age, sex, colour, and periods of settlement, affect the diseases and the mortality of different classes, so that it is necessary to distinguish them. But as the comparison can only be usefully made by reducing the relative proportions to a common standard, say 10,000, which Dr. Jarvis has taken, I have not thought it necessary to give the numbers at each period of age, except for the whole of the United States, distinguishing males and females, and white and coloured populations.

The total number is given as 31,425,480, which differs from the number under districts, 31,399,690, by 28,790, and also in all the districts, and by a much larger number, from the table in which the increase of population is shown, 30,705,290. In this table District IV. alone differs by more than 674,000, and District IX. by nearly 10,000. Table N also, which shows the growth of population in all the nine districts for the last 10 years only, differs from both these tables. There may be reasons for these discrepancies, but they do not appear in the Report.

I have given the table as printed in the Report, to 10,000 of each sex, though I think the better proportion would have been for 10,000 of both sexes, as the ratio of males to females at each age would then be more easily seen. But I have added the actual total numbers from which these relative proportions can be deduced, as well as the actual numbers living at each age and of each sex, by anyone who desires to extend this inquiry and has not the original Report to refer to. (Table C.)

This is a table which allows of several points of comparison of great interest. The district which shows the largest proportion of white children under 15 is VIII. (Mississippi, Louisiana, Arkansas), being 4,471 in 10,000. The one which shows the least, with the exception of IX., is District I., being only in the proportion of

3,446 in 10,000 of the whole population. District IX., California, New Mexico, &c., is wholly exceptional, comprising so many new scarcely-settled territories. Here the proportion of children under 15 is only 2,792 in 10,000 of both sexes, but the number of female children is so greatly in excess of the males, that whilst the former show a proportion of 4,333 the latter are only 2,088 in 10,000. But in this district, in the middle periods of life, the males vastly predominate in numbers, being from 20 to 50—6,925 males to 4,264 females in 10,000 total population of each sex.

In none of the other districts is there any such material difference in the numbers of the sexes at any of the periods of life. Under 15 the largest proportion of female children is in District VIII., 4,666, where the male children under the same age are 4,301 in 10,000; and the smallest proportion of females under 15 is in District I., 3,382, where the males under the same age exceed them in numbers, being 3,517 in 10,000.

The same remark with regard to the District IX. may be made of the coloured population. The females under 15 are 3,105, whilst the male children are only 1,426, in 10,000 of each sex; whilst from 20 to 50 the males exceed the females in the proportion of 7,196 to 5,485 in every 10,000 of each sex. In actual numbers the disproportion is greater still, as there were only 1,402 females to 3,077 males in the whole district.

The total number of white males in the United States was given as 13,844,028, of females 13,112,934, showing an excess of males 731,094, or 105·6 males to 100 females.

In England and Wales only, at the census in 1861, the males were found to be 9,825,246, the females 10,380,258, an excess of 555,012 females, or 94·65 males to 100 females. The total population of Great Britain was then found to be 29,031,164.

The total males of the coloured population of the United States is given as 2,216,738, and females 2,225,990, showing the small excess of 9,252 females.



C.—Population of the United States in 1860, classed under Ages.

Ages.	PROPORTION TO 10,000 OF ALL AGES.					
	WHITE.			COLOURED.		
	Males.	Females.	Persons.	Males.	Females.	Persons.
Under 1	409,914	397,527	807,441	61,642	64,818	126,380
1 to 5	1,681,569	1,628,485	3,310,054	293,537	299,267	592,804
5 " 10	1,788,731	1,739,404	3,528,135	317,999	319,807	637,806
10 " 15	1,590,785	1,523,314	3,114,099	307,374	294,277	601,651
15 " 20	1,402,432	1,452,476	2,854,908	245,104	256,490	501,594
20 " 30	2,512,116	2,421,001	4,933,117	394,185	389,418	783,503
30 " 40	1,878,302	1,636,525	3,514,827	247,378	253,129	500,507
40 " 50	1,227,858	1,058,317	2,286,175	162,220	162,299	324,519
50 " 60	741,348	659,264	1,400,612	93,106	90,588	183,694
60 " 70	400,706	380,023	780,729	53,906	52,564	106,470
70 " 80	153,663	156,584	310,247	18,629	19,555	38,184
80 " 90	38,005	42,753	80,758	5,631	6,903	12,534
90 " 100.	4,135	5,634	9,769	1,644	2,241	3,885
100 and upwds.	385	542	927	799	1,140	1,939
Unknown	14,079	11,085	25,164	13,764	12,394	26,158
	13,844,028	13,112,934	26,956,962	2,216,738	2,225,990	4,442,728

C (continued).—*Population in 1860, classed under*

WHITE.								
Ages.	DISTRICT I.		II.		III.		IV.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
Under 1	259	258	303	331	304	295	320	336
1 to 5	1,062	1,019	1,310	1,429	1,224	1,204	1,308	1,365
5 " 10	1,155	1,113	1,294	1,402	1,316	1,296	1,350	1,418
10 " 15	1,041	992	1,080	1,146	1,161	1,134	1,190	1,218
15 " 20	994	1,050	944	1,053	1,024	1,096	1,061	1,150
20 " 30	1,777	1,962	1,748	1,764	1,703	1,830	1,796	1,796
30 " 40	1,425	1,395	1,466	1,303	1,311	1,265	1,286	1,181
40 " 50	1,021	939	943	788	918	844	816	743
50 " 60	652	630	543	454	561	535	500	445
60 " 70	388	398	262	227	316	320	254	235
70 " 80	170	184	82	72	124	136	88	84
80 " 90	44	54	15	14	29	35	19	19
90 " 100	4	6	1	1	2	4	2	2
100 & upwds.	..	..	..	..	..	..	..	..
Actual Nos.	3,441,151	3,500,919	902,708	805,218	1,750,676	1,745,282	3,176,693	2,949,285
COLOURED.								
Under 1	224	210	291	346	259	240	281	292
1 to 5	897	839	1,148	1,333	1,036	986	1,185	1,180
5 " 10	1,087	1,022	1,269	1,450	1,238	1,151	1,360	1,396
10 " 15	1,152	1,023	1,089	1,213	1,255	1,145	1,312	1,304
15 " 20	992	1,060	884	1,104	1,074	1,128	1,078	1,218
20 " 30	1,764	1,922	1,930	1,961	1,731	1,981	1,811	1,843
30 " 40	1,490	1,499	1,607	1,282	1,266	1,312	1,196	1,122
40 " 50	1,147	1,087	966	732	988	959	791	780
50 " 60	664	673	521	300	614	571	533	443
60 " 70	369	385	209	155	333	328	280	246
70 " 80	152	178	61	76	139	152	110	107
80 " 90	37	67	9	35	48	61	35	45
90 " 100	13	20	4	5	10	20	13	10
100 & upwds.	4	6	4	2	2	8	7	6
Actual Nos.	34,897	38,819	4,387	3,930	38,785	43,482	28,894	28,531

*Ages, in Districts.—Proportion to 10,000 of all Ages.*

WHITE.									
V.		VI.		VII.		VIII.		IX.	
Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
301	289	327	338	316	315	299	327	199	421
1,248	1,212	1,318	1,359	1,290	1,285	1,311	1,425	751	1,575
1,381	1,336	1,407	1,468	1,463	1,471	1,438	1,564	648	1,368
1,269	1,220	1,263	1,300	1,373	1,364	1,253	1,350	490	969
1,066	1,111	1,059	1,166	1,100	1,200	983	1,162	489	903
1,694	1,791	1,837	1,805	1,742	1,768	1,881	1,801	3,232	2,169
1,203	1,189	1,233	1,125	1,113	1,085	1,318	1,136	2,736	1,450
850	829	767	702	750	702	832	664	957	645
529	525	452	408	464	433	429	346	346	309
298	312	226	217	261	244	186	158	113	130
117	130	81	83	93	95	50	48	25	38
30	38	21	22	24	27	10	12	7	12
4	5	2	3	3	5	1	2	1	3
..	..	..	..	..	..	..	..	..	..
1,174,875	1,169,636	1,460,103	1,349,592	758,544	728,324	775,983	680,406	403,295	184,272
COLOURED.									
273	286	313	319	284	295	262	289	130	314
1,319	1,335	1,421	1,436	1,389	1,394	1,283	1,341	549	1,192
1,472	1,465	1,569	1,567	1,463	1,457	1,362	1,392	442	864
1,465	1,379	1,492	1,434	1,420	1,344	1,270	1,236	305	735
1,117	1,131	1,163	1,175	1,116	1,151	1,091	1,197	377	807
1,662	1,632	1,725	1,645	1,760	1,743	1,996	1,954	2,504	2,250
1,047	1,092	1,013	1,059	1,101	1,142	1,241	1,209	2,920	2,128
711	723	622	647	716	729	800	754	1,772	1,107
473	470	385	384	390	389	393	350	760	500
294	293	197	208	238	228	212	189	165	78
113	121	66	78	80	81	58	57	61	14
34	44	20	27	24	27	17	18	9	..
9	14	5	8	7	8	5	5	..	..
3	6	1	4	4	4	3	4	..	7
559,275	558,228	317,075	320,524	682,803	695,662	547,545	534,412	3,077	1,402

*Dependent and productive ages.*—One of the most important questions connected with the census is to ascertain what part of the population is to be found at ages dependent upon the exertions of others for support, and what part may be considered as adding by their labour or educated skill to the productiveness and wealth of the whole country. It is generally understood that in the United States, amongst the native population, the age at which children begin to be independent of the exertions of their parents is much earlier than in the old countries of Europe. This may be due to a variety of causes, but principally to the wide field opened for enterprise, either in bringing uncultivated lands into use, and the early profits with which a rapidly-increasing population rewards such exertions, or in commercial and industrial pursuits, which for the same reasons raise the value of labour, whether skilled or natural, in the market, and tempt youth earlier into the active pursuits of life.

We shall not be far wrong in assuming that from birth to 15 may be called dependent ages, and though from 15 to 20 may be spent in acquiring the preliminary knowledge of a business or profession, it is only from 20 to 60 that on an average labour or skill will be found to produce an excess so as to contribute to the support of others, such as is implied in the maintenance and education of a growing family. No doubt there are individuals and whole professions and occupations which afford an excess of productive power after the latter age, but for the purpose of inquiry into the averages of a whole nation these limits of age are sufficiently wide for examining the distribution of the population.

*D.—Ratio in 10,000 of Population of the United States in 1860 under 20, 20 to 60, 60 to 80, and above 80 Years of Age.*

District.	WHITE.				COLOURED.			
	Under 20.	20 to 60.	60 to 80.	Over 80.	Under 20.	20 to 60.	60 to 80.	Over 80.
I.	4,468	4,901	570	54	4,248	5,125	544	75
II.	5,133	4,526	322	16	5,044	4,670	251	28
III.	5,027	4,483	448	35	4,750	4,691	476	75
IV.	5,354	4,286	331	21	5,303	4,260	372	58
V.	5,218	4,306	428	38	5,623	3,906	410	56
VI.	5,496	4,168	304	25	5,944	3,739	274	34
VII.	5,558	4,030	347	29	5,658	3,985	313	38
VIII.	5,538	4,221	222	12	5,360	4,349	259	26
IX.	3,412	6,425	148	10	2,462	7,339	184	8
England . . . .	4,504	4,759	679	55				
France . . . .	3,318	5,623	990	67				
Belgium . . . .	4,131	4,973	817	76				
Sweden . . . .	4,491	4,723	733	52				

In the older States on the Atlantic coast the proportion under 20 is the smallest, and between 20 and 60 the largest, of all the States, except District IX. Here, as we have constantly remarked, the newness of immigration throws the greatest proportion into the middle and active periods of life. The largest proportion under 20, and the smallest from 20 to 60, is found in Districts VI. and VII., in which likewise the coloured population gives similar results, but to a still greater degree, they being principally slave States. The inference we draw is, that the unhealthiness of climate and other social causes tell in these districts unfavourably upon the constitution at an earlier period of life, leaving a much smaller number to attain the productive and advanced ages of life.

In the comparison added of some of the European populations, it will be seen that England and Sweden, with nearly the same proportion under 20, both show a smaller proportion between 20 and 60 than District I., the old Atlantic States of America, but a much larger proportion in the old-age periods. France, on the other hand, having a much smaller proportion under 20 than either any of the European nations or American States, shows a higher proportion than any between 20 and 60, and a still higher relative proportion at the advanced ages.

In the whole of the United States the proportion of the people under 15 is given as 40·5 per cent., in England 35·4 per cent., in France only 28·7 per cent.; and between 15 and 70, in the United States 58 per cent., in England 61·9 per cent., in France 67·5 per cent.

*Military ages.*—For the purpose of considering the defensive (we trust the term will always be more appropriate than the aggressive) strength of a nation, the proportion of the male population constantly living between 20 and 40 must be taken, not as implying that all could be abstracted from labour to engage even for a time in military service, since even warriors must at least be fed and clothed, but as showing the usual limits within which the military strength of a nation is confined. It indicates, in comparison with other countries, what are its reserves of force, and its power of sustaining prolonged wars.

In the United States the actual numbers between 20 and 40 were stated to be 5,030,981, or 3,137 in 10,000 of the whole  
 16,060,666  
 male population; but this includes the coloured population, of whites only it would be 4,390,418=3,171 in 10,000.  
 13,844,028

In England at the same ages,  $\frac{4,686,657}{9,963,425}$ , or 4,703 in 10,000

males. In France,  $\frac{5,450,551}{17,800,219} = 3,062$  in 10,000 males.

Dr. Jarvis gives the numbers of the male population between 20 and 40 in the late wars of the loyal States as 3,606,147, against 825,400 of the disloyal States; in which I presume he does not count the black population, though they are included in the first estimate of numbers at the military ages.

*Foreigners.*—One of the most striking peculiarities of the population of America is the large proportion of foreigners to be found at every census. This, in fact, and not the fertility or healthiness of the native population, is the cause of the extraordinarily rapid growth of the nation. In one sense the portion of population which comes from a foreign country may rather be considered as the sign of the growth and rapid increase of the country from which it comes, than of the newly-adopted country, since they spring from the former, and by their secession leave room for the labour and sustenance of a new population, by whom the void caused by emigration is rapidly filled.

Almost every nation in Europe, and Asia too in great part, sends its representatives to the United States. In 1860 no less than 4,136,175 foreigners were found by the census in the different States, and there was scarcely a State which did not contain one at least of the natives of almost every country in Europe. There was no Russian in New Hampshire, no Spaniard in Arkansas, no Belgian and no Austrian in Delaware, no Wirtemberger nor Norwegian in Vermont; but with these exceptions there were some of all classes of foreigners in each State.

*Migration.*—There is also a constant migration from one State to another, not absolutely caused by want of means of subsistence, but by ambition to rise in life, and take advantage of the constant new openings which may be found in a country which, whether in agriculture, industry, or commerce, presents such incessant movement, progress, and change. In Colorado territory there were but 312 in 100,000 persons born in the territory; 91,040 were born in other States, 77,777 were born in foreign countries, 2 at sea, and 866 unknown. On the other hand, in North Carolina 95,866 in every 100,000 were born in the territory, 3,604 in other States, only 498 in foreign countries, 1 at sea, and 29 unknown.

In the whole of the United States in 1850 the number of the white population living in their native States was 13,540,832, or

76·6 per cent., leaving 23·4 per cent. living out of them. In 1860, 17,527,069, or 75·2 per cent., in their native States, and 24·8 per cent. out of them. In England the proportion living in the counties in which they were born, in 1851 was 75·1, and in 1861 75·4 per cent. But there is a great difference between an English county and an American State. If the counties in each State of America were similarly examined, the proportions of those who had emigrated from one part to another would be found vastly increased.

The migration of the native population is generally from the east to the west, from the older States to the new, as is easily seen by the rate of increase shown in Table B.

*Irish emigrants.*—It is a singular result of emigration, that both the Irish and the Germans, who form together by far the largest proportion of foreigners seeking a new home in the United States, and who are, in their own country, generally small farmers or of the agricultural class of labourers, seem on their arrival generally to change their occupation, and settle as labourers in commercial and manufacturing cities and towns. This may arise from want of sufficient capital to take and cultivate land, or from the high wages by which they are tempted where manufacturing labour is so scarce. The Irish emigration returns showed that 84·5 per cent. of Irish male emigrants above 15 years of age, and 92·1 per cent. of those under 15, and of the females 79·4 per cent. over 15, and 88·3 per cent. of those under 15, were connected with agriculture. But on examining a table showing the ratio of American, foreign, Irish and Germans, in city populations and in the rest of the State, it is found that in the city of New York the Irish constituted 23 per cent. of the population, but only 12 per cent. of the population in the rest of the State; 16 per cent. of the town populations of Philadelphia, Alleghany, Pittsburg and Reading, and only 4 per cent. of the rest of the State.

*Foreign immigrants.*—The records of foreign emigration are not very complete from 1800 to 1820; but since 1819 the numbers have been officially published, and from that date to 1st June, 1860, they are stated to be—

Males . . . . .	2,918,619
Females . . . . .	1,993,162
Sex not stated . . . . .	48,408
Total . . . . .	<u>4,960,189</u>

Of the foreign arrivals some, of course, proceed through the States to the British possessions in America and other parts; but

it is only since 1854 that it has been ascertained that about 2·3 per cent. of the males, and 1·3 per cent. of the females, intended to proceed beyond the United States.

	Males.	Females.	Total.
On 1st June, 1850, the number of foreign emigrants living in the States was found to be . . .	1,239,434	1,001,101	2,240,535
On 1st June, 1860, they had increased to . . .	2,225,379	1,906,307	4,131,686

From 1st October, 1819, to 31st May, 1860, upwards of 5,000,000 of foreigners arrived in the United States; and as almost every country in Europe, Asia, and Africa, contribute to swell this multitude, I subjoin the following interesting table of the nativity of the emigrants:—

*E., showing the Nativity of Foreign Emigrants to the United States from 1819 to 1860.*

Country.	Number.	Country.	Number.	Country.	Number.
England . . . . .	302,665	Italy . . . . .	11,202	Sandwich Islands	79
Ireland . . . . .	967,366	Belgium . . . . .	9,862	Cape Verde Is- }	29
Scotland . . . . .	47,890	South America . .	6,201	lands . . . . }	
Wales . . . . .	7,935	Denmark . . . . .	5,540	Asia . . . . .	27
Gt. Britain and }	1,425,018	Azores . . . . .	3,242	Persia . . . . .	22
Ireland . . . }		Portugal . . . . .	2,614	Liberia . . . . .	19
Total . . . . .	2,750,874	Sardinia . . . . .	2,030	St. Helena . . . .	17
Germany . . . . .	1,486,044	Poland . . . . .	1,659	Iceland . . . . .	10
France . . . . .	208,063	Russia . . . . .	1,374	Corsica . . . . .	9
British America	117,142	Central America	968	Society Islands.	7
Prussia . . . . .	60,432	Sicily . . . . .	560	Morocco . . . . .	5
China . . . . .	41,443	Europe . . . . .	526	Egypt . . . . .	4
West Indies . .	40,487	Madeira Islands	314	Barbary States .	4
Switzerland . . .	37,733	Canary Islands .	286	New Zealand . .	4
Norway and }	36,129	Africa . . . . .	279	Isle of France . .	3
Sweden . . . }		Turkey . . . . .	170	Cape of Good }	2
Holland . . . . .	21,579	East India . . . .	127	Hope . . . . }	
Mexico . . . . .	17,766	Malta . . . . .	119	Algiers . . . . .	2
Spain . . . . .	16,248	Greece . . . . .	116	Not stated . . . .	180,854
		Australia . . . . .	109		
		South Sea Islands	79	Total aliens	5,062,414

Dr. Jarvis states the number of emigrants who arrived in the ports of the United States from 1st June, 1850, to 1860, with the intention of remaining, as—

Males . . . . .	1,526,848
Females . . . . .	1,107,092
Total . . . . .	<u>2,633,940</u>

In the English Census, 1861, the number of emigrants who left Great Britain in the 10 preceding years is stated to be 2,249,355;



of whom 194,532 were foreigners, and 1,230,986 Irish. But these were not all destined to the United States.

*Defects in registration of mortality.*—However defective the collection of facts made by the marshals was as to the living population in 1860, it was greater still as to the registration of deaths, which it was intended to perfect for the year ending 1st June, 1860. Mr. De Bow, the Superintendent of the Census for 1850, in his excellent summary of the larger Report, admitted that in that year the schedules were wholly unreliable, and could not furnish the materials for comparing the deaths with the living. Consequently no mortality table could be computed direct from the facts. In 1860 no greater success seems to have attended the effort. The Reports given in by the marshals are deficient on the very face of them. Some even appear to have thought the matter of no consequence as compared with the schedules of the living; and whole counties and towns, both in 1850 and 1860, were returned without any death in the year. Some of the marshals were not intelligent enough to carry out their instructions. Others appear to have trusted to their memories, and recorded the facts at leisure. Even where they were honest, faithful, and painstaking, the difficulties were great enough. Some families might have been dissolved as households by the death of the father or mother, or both, and no one was there to record the family events. If the parents were living, but away, a boarder or visitor, or servant or neighbour, might be called upon to answer, and what accuracy could be expected in reports so obtained? Who, also, would take the trouble to respond for the deaths of strangers, or for those which had taken place in taverns, boarding houses, or on ship-board?

Again, we have the treachery of memory to add to the other liabilities to error. Except in the case of parents answering for their children, the deaths that took place from 3 to 6, 9, or 12 months before might be wholly omitted, or placed in the wrong month, or attributed to the wrong cause. Thus the whole Reports appear to be totally unreliable, so far as it is desired to form an accurate table of mortality from them direct.

The deficiencies vary much in different States. Those in which the largest number of stationary families are found naturally afford their returns most complete. But the mortality differs from 1 in 228 in Washington territory to 1 in 48 in Arkansas. In Massachusetts, where a proper registration has been in force for 17 years, the reported deaths do not differ very much from those furnished

by the local authorities. But even here it is admitted that in some localities the officials report only such births and deaths as they happen to hear of. Mr. E. B. Elliott, a very able writer on these subjects, thinks that only 166 out of 331 towns, just one-half the number, gave reliable accounts of the mortality. The registers, however, seem increasing in accuracy by degrees. In 1855, 1·84 per cent., in 1860, 1·96 per cent., and in 1863, 2·22 per cent. of the calculated population in that State were returned as deaths, an increase which, it is argued, is not an increase in the actual mortality, but only in the accuracy and care with which the records are kept.

*Comparative mortality.*—In 1850 the deaths amongst the white and coloured population were distinguished; but in the present census no distinction of race, colour, or nativity has been made; but the causes of death, the sex and age, are recorded for each district. The deaths are accordingly shown as returned, in a series of elaborate tables—the nomenclature of the diseases being reduced in the Census Office to 124 names, and classified under the same heads as Dr. Farr has used in his Reports of the English Census. This system, which is now extensively used on the continent of Europe, was introduced into America by the American Medical Association, in 1846, and forms the basis of classification of diseases for the Census Reports of 1850 and 1860.

Dr. Jarvis concludes that, however defective the actual returns of mortality may be, the omissions may fairly be considered as bearing in most particulars the same proportion as those that are known. Consequently he infers, that, out of a given number of reported deaths, the proportion occurring by certain diseases under or above certain ages in some localities may be compared with similarly-ascertained proportions in other places. Likewise that the proportions in months will allow of a similar safe comparison.

But this manifestly depends on the living population of the compared districts being somewhat alike as to proportions existing at different ages. The diseases which afflict childhood, manhood, or old age, are markedly different. There cannot be a better exemplification of this fact than the records of the Gotha Life Office in Germany, in which the deaths and diseases at all ages have been so carefully analyzed by Mr. Neison, in the *Statistical Journal*, vol. xiii. Unless, therefore, the compared populations have nearly similar proportions of numbers living in childhood, youth, manhood and old age, and also the due ratio of the sexes to each other, an excess of mortality by one class of diseases may

depend, not upon an unusual rate of death, but to there being a greater number living liable to such cause of mortality.

We have already, in Table C, seen how widely the proportions living at different ages differ in the enumerated districts, and I will, therefore, only briefly refer the reader, and especially the medical reader, to the comparisons and conclusions which Dr. Jarvis draws from the tables, and proceed to examine the table which he finally gives as the only one showing the actual rate of mortality in the United States of America during the last decennial census period to 1860.

*Rate of mortality, 1850 to 1860.*—The table from which alone, out of all the elaborate and carefully-prepared tables given in the Report, the actual mortality in the whole of the United States during the decennial period to 1860 can be approximated, is not taken direct from the numbers of deaths reported by the marshals, but has been obtained by certain calculations and deductions from the two Censuses of 1850 and 1860. Assuming that the returns of the living are in both cases accurate, that there was no increase of the population by immigration, and no diminution of it by emigration, but only by death, in the two periods, the survivors of the population between each ten ages at one census will at the next decennial census be living between the ages respectively ten years older. The diminution from one period to the other would then be the deaths which have occurred in the interval, and thus an approximate rate of mortality may be obtained for the ten years.

The white populations of the different States have been much influenced by emigration and by migration from one to another during the period in question. As between the North and the South the interchange of the native population is considered to have been so nearly equal, and the compensation so far complete, that, for the purpose of this deduction, each section may be reckoned upon having retained all its own children and received none from the other. Then with regard to the foreign immigrants, a careful analysis was made of those who arrived between 1850 and 1860; their rate of mortality has been computed, and the survivors separated from the total whites at the corresponding ages, thus reducing the numbers by the Census of 1860 to the survivors of those in 1850.

But the Census of 1850 was manifestly incomplete at the early ages of life, as the computations by this process would actually show no deaths amongst those who were under 5 in 1850, and should be between 10 and 15 in 1860. Consequently, under 10

the ages in the table are wholly omitted, and no comparison can be made.

Dr. Jarvis does not give the computations on the ages of the emigrants by which he arrived at the rate of decrement in the ten years, though he gives the final results, showing a mortality of 2·815 per cent. amongst the male emigrants, and 1·453 per cent. amongst the females. With these explanations we must take it on trust, based on his experience in the comparison of facts, and on the earnest fidelity with which he has endeavoured to arrive at the truth. But we should have been glad of some information as to the ages and actual rate of mortality amongst the emigrants in the decennial period, so as to see by what process the number of survivors in 1860 was ascertained. The table used was the English Life Table, checked by further computations by the Irish Life Table.

In regard to the coloured population these computations are unnecessary. None are amongst them, except those who were born in the land, and very few indeed are stated to have left it, so that the comparison of the coloured populations at each census suffices for the table on the principle explained.

By taking the mean age of entering on the decennial period, and dividing Dr. Jarvis' numbers by 10, the average annual mortality will be obtained in a form to compare with the mortality in England for nearly the same period.

*F., showing the Annual Rate of Mortality per Cent. in the White and Coloured Populations of the United States on the Average of the 10 Years 1850 to 1860.*

Mean Ages.	WHITE.				COLOURED.				ENGLAND, 10 YEARS 1851 TO 1860. ANNUAL RATE OF MORTALITY PER CT.	
	North.		South.		North.		South.		Males.	Females.
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.		
15-25	·560	·620	1·007	1·375	..	..	1·169	1·335	·766	·796
25-35	2·169	2·470	2·077	2·455	1·645	2·143	2·116	2·197	·957	·993
35-45	1·330	1·445	1·883	1·783	1·828	1·777	1·905	2·202	1·248	1·215
45-55	2·202	2·001	2·544	2·556	2·710	2·718	2·687	3·084	1·796	1·520
55-65	2·120	1·866	3·117	2·886	3·541	3·199	2·955	2·908	3·086	2·701
65-75	4·080	3·730	5·014	4·787	5·081	4·416	5·891	5·629	6·533	5·866
75-85	6·480	6·010	6·862	6·513	6·288	5·171	6·505	6·039	14·667	13·434
85-95	8·730	8·400	8·660	8·213	7·118	6·598	7·044	6·396	31·008	28·956
95 & upw <sup>ds</sup> .	9·100	9·140	8·591	5·789	5·789	5·829	4·696	4·167		

The most remarkable part of this table is, the much smaller decrement in each decade after 75 years of age amongst the coloured, both male and female, and both in the North and the

South, than amongst the whites. Indeed, in the original returns, the proportion of blacks living to whites above 80 is so great, whilst from 70 to 80 the relative number sinks suddenly, that it is manifest the latter ages have been favoured at the expense of the decade after 70. The blacks living at 80 to 90 are given as nearly equal to the whites; but at 90 to 100 the males are  $2\frac{1}{3}$  times as numerous, and the females  $1\frac{3}{4}$  times; and above 100 they are actually 11 or 12 times the number of the whites.

In the Census Returns, 1860, the whites above 100 are given as 385 males and 542 females, and the coloured with one-sixth of the same population as 799 males and 1,140 females above 100 years of age. No doubt the marshals, in their strict recording of facts stated to them, have, without further inquiry, taken the common phrase of the negroes, "most a 100" or "more than a 100," as literally true. The common tendency of very old people to exaggerate their age expands to still wider dimensions amongst the imaginative blacks.

The table above given is now, as far as the approximation can be relied on, in the form in which it can be compared with European tables. Dr. Jarvis's table showed, for instance, that of 1,299,299 white males in the Northern States between 20 and 30 in 1850, there were 1,041,191 between 30 and 40 in 1860; the difference or decrement being 258,108, or 19·86 per cent. in ten years on the former number. The rate of decrement given against these ages in his table is 21·69. The actual decrement on the mean of those two numbers living would be 22·06, whence we infer that, with some slight corrections, which have probably been carefully made, the numbers in this table divided by 10 would give the average annual mortality on 100 living at the mean ages between the two periods—that is, at 20, 30, 40, 50, 60, 70, 80, 90, 100, or between 15–25, 25–35, &c. I have accordingly added, from the Registrar-General's 25th Report, the average annual mortality in England for the ten years 1851 to 1860, between the ages 15–25–35, &c., of males and females, above assumed, for comparison with the rate of mortality in America during nearly the same period of years.

It will be remarked, that for the male whites in the North the rate in America is much above the English rate up to the age of 55, whilst above that age it is so very materially less as to give rise to great suspicion of the real truthfulness of the results. For the female white population of the North the same observation applies, but even in a more marked degree, in the higher rate shown at the

ages of 25–35; and above the age of 55 the low rate of mortality is still more remarkable when compared with English female life.

Amongst the whites in the South the rate at ages 25–35 in America is somewhat lower, both amongst males and females, than in the North, but above that age considerably higher up to 85; though it still presents, both amongst males and females above 65, the remarkable feature of showing a very much less rate of mortality at those ages than in England.

In the coloured population of the North the rate of mortality amongst females is much less than amongst males in the North at the ages 55 and upwards; but it approximates much more nearly in the South, whilst under 55 it is considerably in excess of the rate amongst the coloured male population of the South. But even in this class, though the rate of mortality is nearly double the rate of the female population of England at the ages below 55, it actually shows considerably less at the ages above 65.

Considering the composition of the American population, and the new conditions under which the laws of vitality prevail there, we might expect some anomalies in and some differences from the European rates of mortality. But these features of the table are too singular not to require more elucidation on another occasion.

Many other important conclusions might be drawn from a minute examination and careful correction of the details furnished in the Report; but I regret to think that the great bulk of the elaborate tables therein given are, in their present form, too defective to afford safe grounds for argument of any kind. The attempt to collect the statistics of mortality even for a single year, by the census marshals, is clearly a failure, and probably under no circumstances would be trustworthy. Perhaps if their inquiry was confined to the deaths within a month, and they were strictly enjoined to obtain the reports from every family or household, they might be sufficiently accurate for that brief period; but the period itself would be too small for an average if converted into the corresponding rates for a year. The only resource is a much more minute and general registration, in all cases compulsory, of births, deaths, and marriages, as to age, sex, colour, and districts, and whether native or foreign, and especially as to emigrants arrived since the last census.

If, then, the marshals at a future census were required to complete the enumeration in a single night, under the present heads of inquiry, the copies of the registration books would afford the means of elucidating some of the most striking problems in

population and in political and social economy on which at present we are almost wholly in the dark. The mortality amongst emigrants and in the white and coloured populations, the effects of change of climate and occupation, of the quiet cultivation of land, of fevered life in cities, of the excitement of gold-mining or oil speculations, of early or late marriages, of people fleeing from poverty and misery to competence and sometimes sudden wealth, might all find some light thrown on them by a census so carefully conducted. It would be worthy of the wealth and enlightenment of the American nation to make the attempt, and it is not to be expected but that such a country would triumph over all the difficulties which would naturally attend it. These difficulties, we imagine, will stimulate rather than discourage them in effecting the improvements suggested, and in giving to their census the character which it ought to bear amongst the nations of the world.

*On the Construction of Tables by the Method of Differences.* By  
PETER GRAY, F.R.A.S., *Honorary Member of the Institute of Actuaries.*

[Read before the Institute, 25th March, 1867.]

SECTION III.—*On the Construction of Tables in which the Characteristic Function is Rational and Integral.*

(85). We have now to apply the principles laid down in the previous sections to the construction of tables, first of rational, and secondly of irrational, functions. It is only formations of the class last mentioned that are of real importance. A little previous attention to the class first mentioned, however, is desirable, as affording an opportunity of elucidating, under elementary conditions, the arrangement of the work which is found most convenient in practice. The present section will, therefore, be devoted to the formation of successive values of rational functions.

(86). The operation by which successive values of a function are formed, when an initial value and its differences are given, is simply a reverting of that by which, when the requisite number of successive values is given, we thence deduce the differences. The differences being formed by subtraction, the successive values are built up, so to speak, by addition. Thus, take the example in (65), or rather its converse, and let the data be

$$u_x = 1438, \Delta u_x = 541, \Delta^2 u_x = 120, \Delta^3 u_x = 12, \text{ constant};$$

then, arranging them in a line, we ascend to successive values of  $u_x$  as follows:—